MML TM 93-27

COLLOCATED TUNABLE WAVENUMBER SENSOR/ACTUATORS FOR SMART STRUCTURES

N00014-92-C-0214

CDRL A001.15

Covering the period: 1 December to 31 December 1993

Submitted to:

Office of Naval Research
Scientific Officer
Code : 1221

Submitted by:

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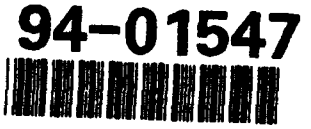
January 7, 1994



Contract progress and activities since CDRL A001.14.

Summary of progress

- The last actuator made it through burnout with only a minor delamination and this was 'healed' by a second isostatic pressing. The actuator was sintered using the following schedule:
  ramp @ 5°C/min to 1185°C; hold for 3 h; cool @ 1°C/min to 800°C; switch off.
  - Unfortunately this actuator cracked during sintering.
- The first full-scale monitoring of weight loss during burnout was completed. This confirmed that burnout of the large actuator is going to completion. The actuator from this experiment will be the next to be sintered.
- The smaller actuators are being tested
  - The short-circuit modulus of the actuators is 15 Mpsi ±10%.
  - The modulus decreases to 12 Mpsi at 1 MV/m
  - The room-temperature strain at 1 MV/m was 390 μstrain (unclamped) and 325 μstrain (under 3000 psi prestress) -- note that these strains will be much larger at 5°C. The hysteresis was <1% for the all the prestress values studied (0-10^4 psi)

Telephone calls, trips, and significant results

- Bridger spoke with the ONR Scientific Officer regarding requests for samples. Bridger will send 5 small actuators to Manfred Kahn at NRL to assist in their burnout studies and Bridger will send some pellets (if available) to Qiming Zhang at Penn. State Univ. but Bridger is not permitted to assist those workers on this contract.

Results bearing on prior problem areas

- The bending problems in measuring actuator performance under stress have been resolved.
- The low rate of spending is not a problem since the current increment must now last until the end of the contract (6/12/94).

Programmatic changes

- None

Technical or scheduling problem areas

- None

Contract and cost schedule status

- Expended funds as of 12 December 1993, including expenditures prior to 23 July, were $192K against a current budget of $280K -- budget will be revised next month.
- A cost schedule, reflecting the 23 July program restart, is attached.

Plans for December 1993

- Electromechanical measurements will be conducted on a stack to measure material properties for comparison with the actuators..
- The next actuator module iteration will complete burnout and be sintered. A fifth and what should be final iteration will be started.

Preparers

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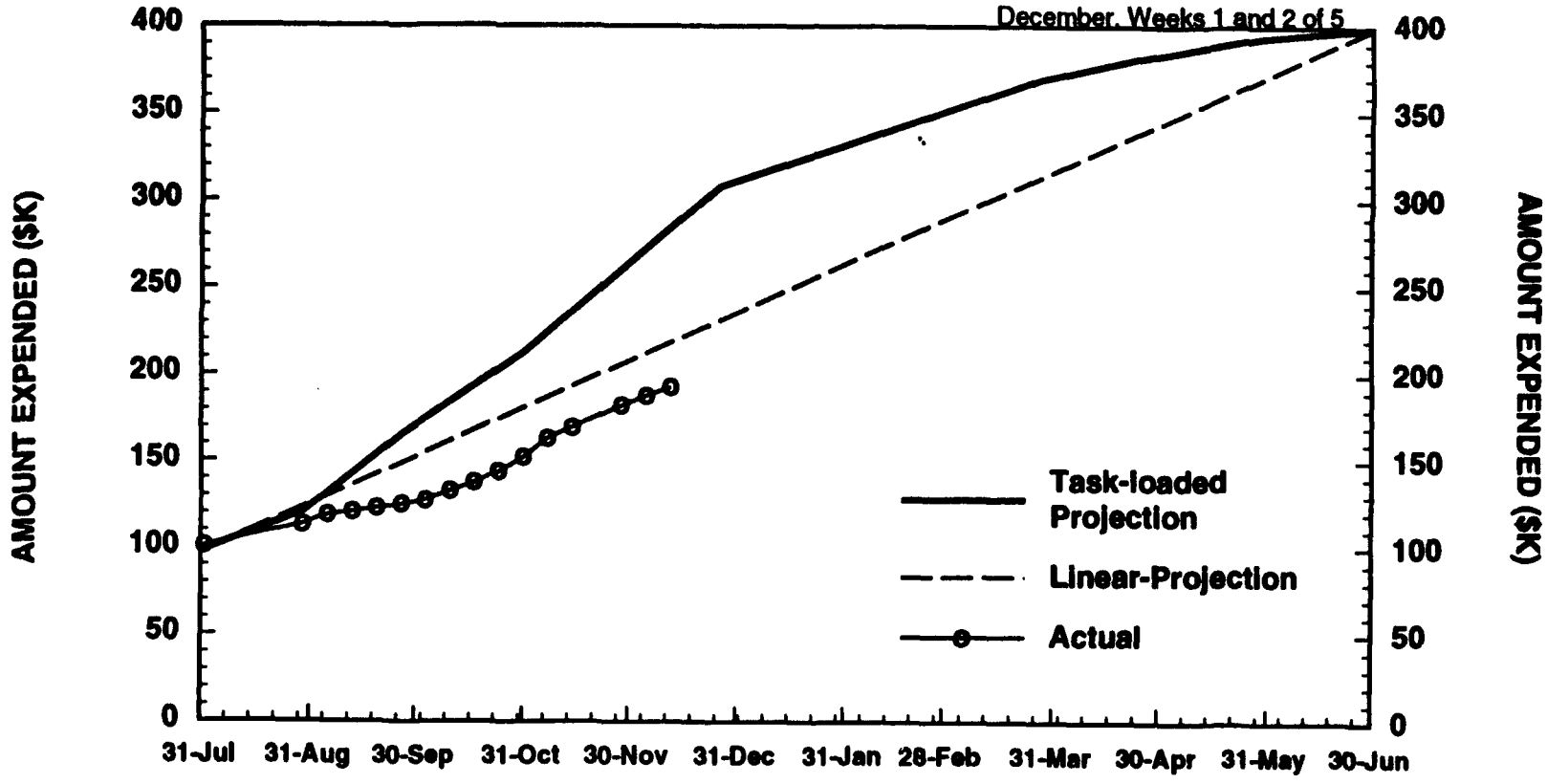
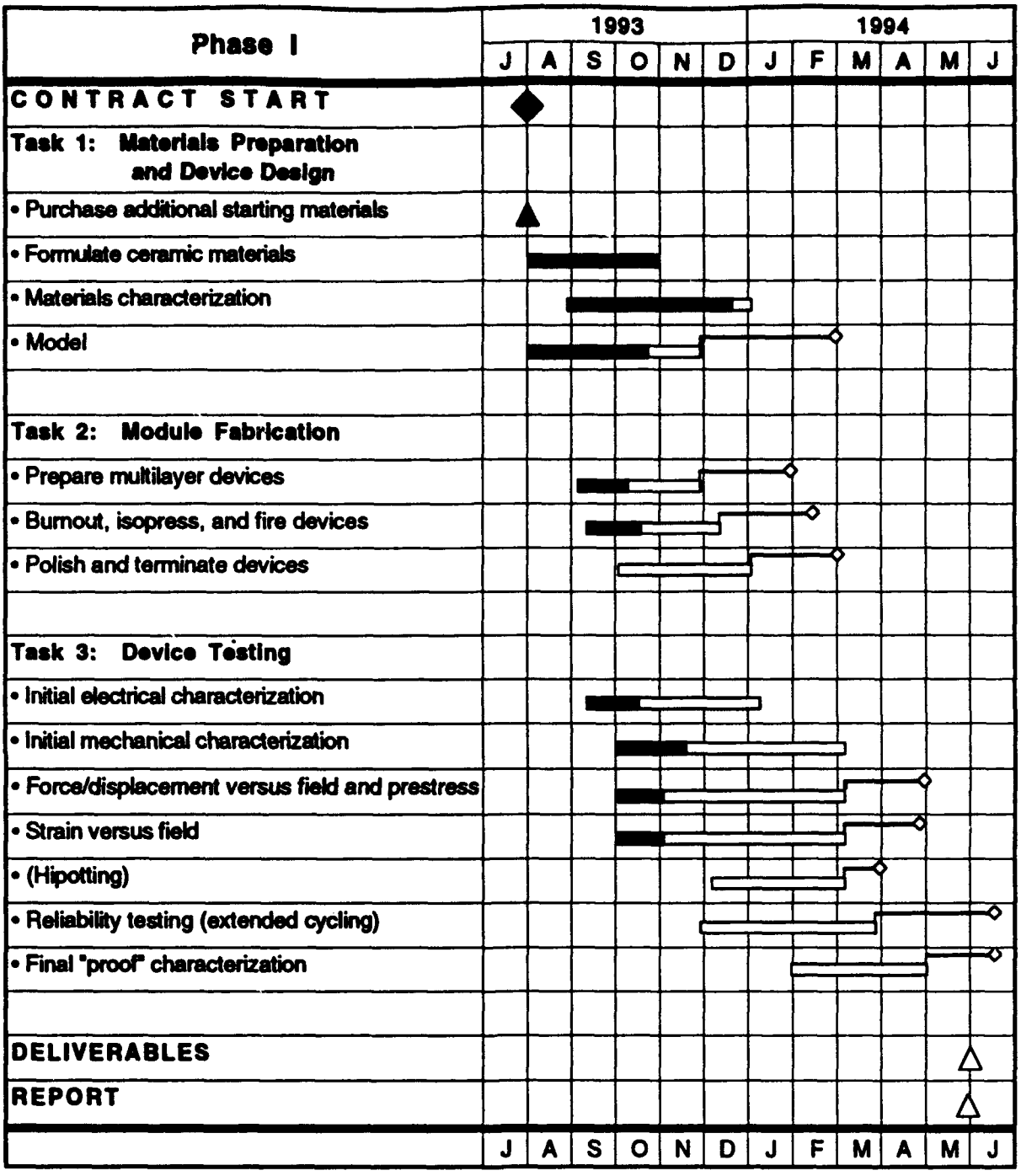
EXPENDITURE CHART

3117-000 ONR
Co-Fired High-Force Actuators



SCHEDULE, MILESTONES, AND DELIVERABLES – Updated January 5, 1994



KEY:

Milestone: △

Planned task: ▭

Completed task: ▬

Task with new projected completion: ▭◇

ONR Sch Miles Deliv Ph-I

Jan 5, 1994